(12) UK Patent Application (19) GB (11) 2 366 273 (13) A

(43) Date of A Publication 06.03.2002

(21) Application No 0021235.7

(22) Date of Filing 31.08.2000

(51) INT CL[7]
B64B 1/00

(52) UK CL (Edition T)
B7W WBA WLX

(56) Documents Cited
EP 0490722 A1
JP 610182559 A
JP 050024584 A
JP 020036707 A
US 5752088 A
US 4729750 A
DE 019742335 A
JP 050221387 A
JP 030280984 A
US 5906335 A
US 5240206 A

(58) Field of Search
UK CL (Edition S) B7W WBA
INT CL[7] B64B
online: EPODOC, JAPIO, WPI

(71) Applicant(s)
Edmund Peter Gortowski
Ardo Old Smithy, Udny, ELLON, Aberdeenshire, AB41 6QX, United Kingdom

(72) Inventor(s)
Edmund Peter Gortowski

(74) Agent and/or Address for Service
Edmund Peter Gortowski
Ardo Old Smithy, Udny, ELLON, Aberdeenshire, AB41 6QX, United Kingdom

(54) Abstract Title
Aerial survey or inspection device with (partially) buoyant envelope

(57) The aerial survey and inspection device, eg. for engineering and structural surveys or searches for missing persons, is free flying, having control via a wireless system and remote telemetry 7, 8, 9. The device is partially buoyant in air, using an envelope or balloon containing a lighter-than-air gas, hence requiring a relatively small lifting and directional control drive system 3, 4, 6, 7. An air flow 5 may be driven by fan/propeller 3 to an air lift outlet 6 which is directional and is controlled by air outlet control unit 7. The device would be controlled by a base operator (or automatic system), and would typically relay its position, heading, and a picture of the area being observed or surveyed. The survey and inspection functions may be realised by a camera 10, 11 (and / or other sensor device(s)), relaying its data through the telemetry to the base station. A wide range of survey and inspection sensors and devices are able to be used. The device may be tethered in a fully buoyant mode of operation, eg for extended surveying in one position, and may have a quiet electric motor with the tethers providing the current path.

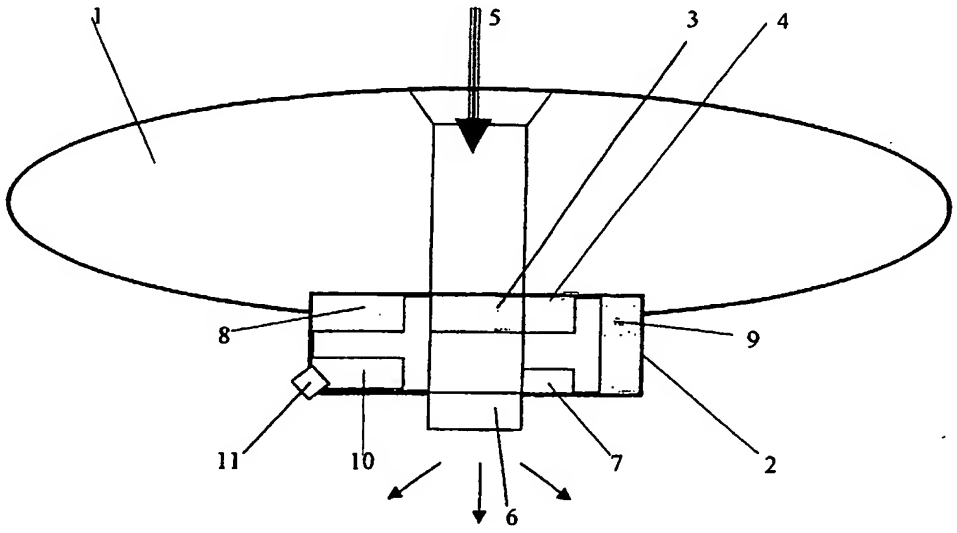

FIGURE 1

GB 2 366 273 A

DCID: <GB___2366273A__I_>

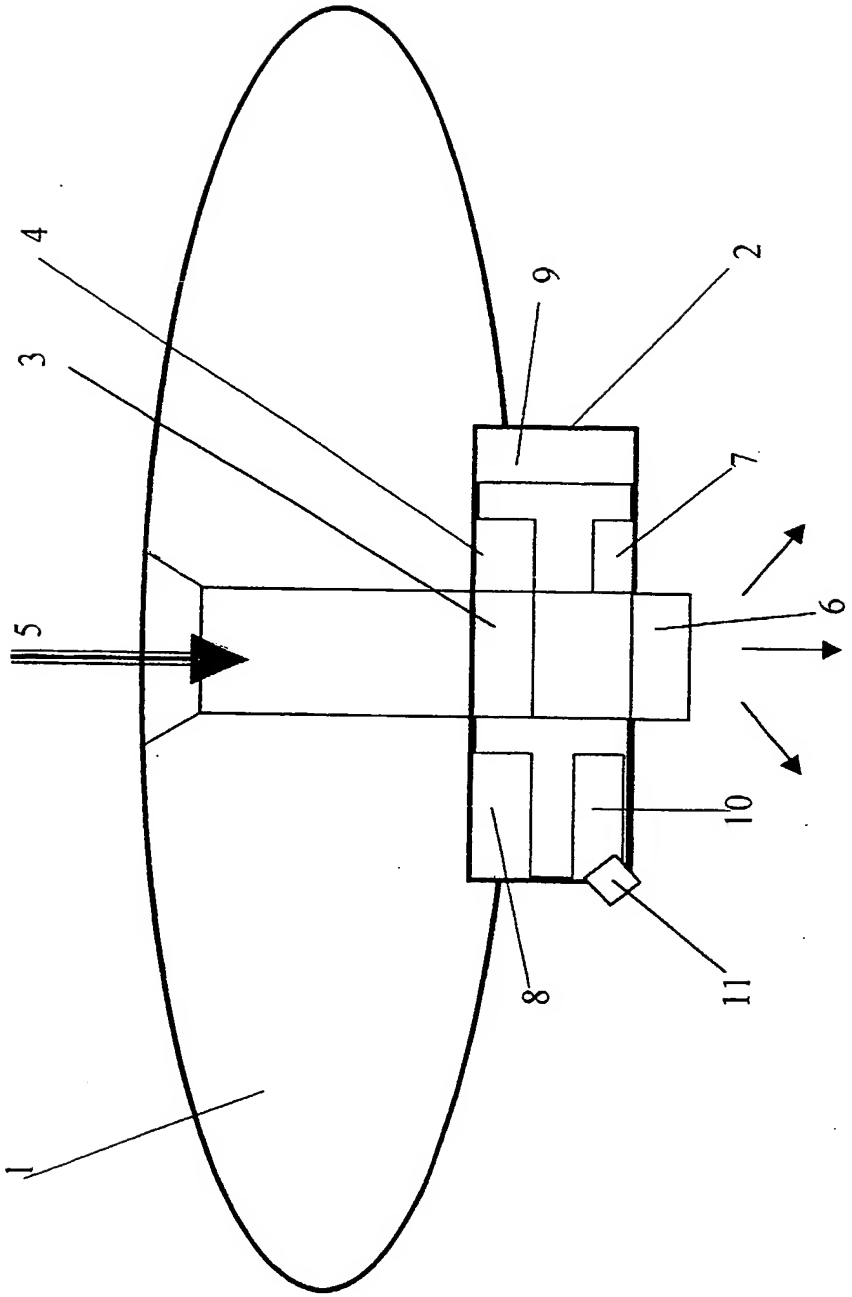

FIGURE 1

AN AERIAL SURVEY AND INSPECTION DEVICE

This invention relates to a free flying aerial inspection and survey device, which allows a very economic, safe and efficient means of achieving these objectives in many circumstances.

There are several existing means of providing free flying aerial inspection and survey, such as helicopters and planes, and these work well in certain circumstances. However, they also have several distinct drawbacks, including high cost (both purchase and operation), exclusion from low and close flying in some circumstances for safety, and usually require very specialised airfields and maintenance / operations staff.

An object of this invention is to provide a more economic means to achieve aerial survey and inspection, for a wider user base, and for applications not currently able to be carried out by existing means.

In summary, this invention is an integrated device, which it is partially buoyant in air, requiring then only a relatively small and economical lifting and drive mechanism, and which also includes a camera (or similar device(s)), operating through remote control and telemetry systems. It is envisaged that the device would be controlled through remote wireless systems by a base operator (or automatic system), and would typically relay (as a minimum) its position, heading, and a picture of the area being observed or surveyed.

Typical applications foreseen include power line and pipeline surveys, engineering and structural surveys of large objects (eg. bridges), searches for missing persons at sea or on land, crowd or crime or security observation, traffic control, farm crop and livestock inspections, and so forth.

The invention can be made relatively small and simple, allowing it to be taken to, or held ready for use, in many places. Also, by its small size, low inertia, and so forth, it can be safely used where conventional aircraft would normally be unwelcome or restricted – for example, for close engineering and maintenance inspection of bridges, power lines and offshore platforms.

Accordingly, the unit can be relatively small and simple allowing it to be rapidly deployed in many circumstances, and the economical nature of the device will allow it to be used more frequently than any other previous system.

A preferred embodiment of the invention will now be described with reference to the accompanying drawing in which :

FIGURE 1 shows a cross – sectional side view of the device.

As shown in Figure 1, the device comprises an air buoyancy (air displacement) envelope 1, which contains a lighter than air gas, with an equipment enclosure 2. These are arranged to provide aerodynamic efficiency and the equipment is disposed so as to provide a stable centre of gravity.

The buoyancy envelope or bag 1, provides most of the lift, but is so sized / filled, such that the entire device is just slightly negatively buoyant (ie. just heavier than air). Accordingly, only a relatively small power lift fan 3, and lift fan driver 4, are required to lift and control the flight of the device.

The air through flow 5, enters the device, is driven by the fan / propeller 3, and driver 4, to reach the air lift outlet 6, which is directional and is controlled by the air outlet control unit 7. By this means the lifting and direction of flight of the device can be controlled by the external operator, via a remote control link (such as by wireless telemetry).

By a combination of varying the power applied, fan speed (and blade pitch if fitted), and the outlet air control nozzles, and so forth, the machine can be made to lift up, lower, fly in a given direction, and also to hover in the air.

Within the equipment enclosure 2, there will also be the necessary instruments and equipment required for this operation, including navigation, communication and control instrumentation 8, power storage / battery 9, sensor unit(s) (typically a camera) 10, often with a lens 11. This equipment may be arranged in several different forms of layout and realisation with modern electronics, and within which components that were previously discrete items can be integrated. Of course, whilst this layout describes an integrated equipment enclosure, there may be more than one equipment enclosure, and the devices distributed within these to gain the same overall effect – for example, the electronics may be segregated from the driver motor.

In terms of additional explanation of the device, there are several features and possible variations which are mentioned below for completeness :

The sensor unit(s) may be, in the most obvious realisation, a camera – to which there can be the usual options of pan, tilt and zoom. This may be a video camera to provide a visual feedback to the remote operator, which can then be recorded. In addition, a still picture facility may be incorporated, as also there could be ultra violet, infra red, or radar system for example. A distance sensor may be incorporated to provide information about the separation between the device and a survey subject.

Audio could also be incorporated, in the form of a microphone for picking up sounds, which can then be relayed back to the operator. Also, a speaker system could be incorporated to allow the operator to relay messages, or even music for example.

The driver 4, could be an electric drive, although with current technology a fuel burning motor is probably more likely. The fuel store could have a level / quantity sensing and remote relaying system.

Any change of relative buoyancy (eg. as the fuel is burned) may be compensated for by several means, such as a water condensor (which could use the engine exhaust) whereby the water condensed will be accumulated / dumped to compensate for the loss of fuel weight, or change of air density, for example.

External aerodynamic aids are a possible addition, depending upon the specific application intended.

Lighting may be provided, if so required. This could be to illuminate the viewing system, by visible light, u.v, i.r., for example. Or, it could be to illuminate the area for people being assisted by the device.

Warning and navigation lights would usually be required or preferred.

The sensors could be arranged to face forwards for inspection, or downwards for surveys, or be adjustable between these positions.

With the layout envisaged, the device would be relatively compact (when compared to conventional aircraft) and of low mass, so could operate close up to structures with greater safety, as the results of any collision would be very minimal. In addition, the lifting bag 1, would normally protrude beyond the edges of any solid objects on the device, and as this bag will be of flexible material, it will cushion any impact that may accidentally occur.

For safety, the device could incorporate several features, some of which are noted below :

A parachute could be incorporated to provide a slow descent in the case of sudden loss of lift.

Warning devices can be incorporated to prevent collisions, or warn of the presence of the device.

Lift gas can be non-flammable (eg. Helium) where required.

A homing device(s) may be incorporated to cater with the eventuality of unplanned loss of wireless communications. Additionally, other loss of control automated response functions could be incorporated in the control system, such as warning lights, sirens, a slow descent programme, and similar effects.

The buoyancy envelope may have several cells, to prevent total deflation in the event of damage to the integrity of the envelope.

If so required, lightweight external utility tools, or similar, may be fitted to the exterior of this invention. For example, a surface scanning tool upon an arm could be employed in structural survey work.

It is also foreseen that this device could have an alternative means of deployment, if so desired, in that it could be tethered in a fully buoyant mode (ie. simply floating on wires or ropes). This mode could be used for an extended use survey or inspection in one position, whereby it would remove the need to replenish the fuel or energy supply to the driver, whilst allowing the elevated sensors to be used. In addition, it would be silent. As examples of applications, this mode could be used for traffic control during the period of road works, or for inspection of a building site, or similar limited period works.

As a further variation, in the tethered mode, the device could have electrical drive (for continuous and quiet operations), with the tethers providing the current path, and if required, a wired means of communication between the ground and the survey device. This would allow for moving and controlling the device within the tether limits.

CLAIMS

1. An aerial survey and inspection device, comprising a buoyant (in air) envelope to provide the major part of the lift, with an engine (or motor) providing the drive for the additional lift and control required for free flight, the control of which will be through a remote wireless system (telemetry) by a base operator (or automatic system), and which would typically relay its position, heading, and a picture of the area being observed or surveyed.

2. An aerial survey and inspection device as claimed in Claim 1 which will include sensor unit(s) which may be, in the most obvious realisation, a camera – to which there can be the usual options of pan, tilt and zoom – which camera may be video or still picture, and / or sensor systems operating in the visible, ultra violet, or infra red spectrums, or a radar system for example.

3. An aerial survey and inspection device as claimed in Claims 1 and 2, in which audio could also be incorporated, for example, in the form of a microphone or a speaker system.

4. An aerial survey and inspection device as claimed in any preceding claim wherein the driving engine (or motor) could be an electric drive or a fuel burning motor, for which the fuel / energy store could have a level / quantity sensing and remote relaying system

5. An aerial survey and inspection device as claimed in any preceding claim wherein any change of relative buoyancy (eg. as the fuel is burned) may be compensated for by several means, such as a water condenser (which could use the engine exhaust) whereby the water condensed will be accumulated / dumped to compensate for the loss of fuel weight, or change of air density, for example.

6. An aerial survey and inspection device as claimed in any preceding claim wherein lighting may be provided, if so required, which could be visible light, u.v, or i.r., for example.

7. An aerial survey and inspection device as claimed in any preceding claim wherein the buoyancy envelope would normally protrude beyond the edges of any solid objects on the device, and this envelope may be of flexible material in order to cushion any possible impact.

8. An aerial survey and inspection device as claimed in any preceding claim wherein the gas envelope may have separate cells.

9. An aerial survey and inspection device as claimed in any preceding claim wherein a homing device(s) may be incorporated to cater with the eventuality of unplanned loss of wireless communications, and additionally, other loss of control response functions could be incorporated in the control system, such as warning lights, sirens, a slow descent programme, parachute and similar.

10. An aerial survey and inspection device as claimed in any preceding claim wherein a distance sensor may be incorporated to provide information about the separation between the device and a surveyed subject

11. An aerial survey and inspection device as claimed in any preceding claim wherein, if so required, external utility tools, or similar, may be fitted to the exterior of this device.

12. An aerial inspection and survey device substantially as described herein and illustrated in Figure 1 of the accompanying drawing.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 0021235.7 **Examiner:** John Twin
Claims searched: 1 to 12 **Date of search:** 20 February 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B7W (WBA)

Int Cl (Ed.7): B64B

Other: online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 490722 A1	(Dassault)	1 at least
X	US 5906335	(Thompson) - see eg the second paragraph	1 at least
X	US 5752088	(Desselle)	1,2 at least
X	US 5240206	(Omiya)	1,2 at least
X	US 4729750	(Prusman)	1 at least
X	DE 19742335 A	(V E R) - see WPI abstract accession no. 1999-245076	1,10,11 at least
X	JP 5-221387 A	(Sanyo) - see Patent Abstracts of Japan, vol.017667, group M1524	1 at least
X	JP 5-024584 A	(Mitsubishi) - see Patent Abstracts of Japan, vol.017304, group M1427	1,2,11 at least
X	JP 3-280984 A	(Takara) - see Patent Abstracts of Japan, vol.01, group C0919	1 at least
X	JP 2-036707 A	(Fujikura) - see Patent Abstracts of Japan, vol.014190, group E0198	1,2 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

Application No: GB 0021235.7 **Examiner:** John Twin
Claims searched: 1 to 12 **Date of search:** 20 February 2001

Category	Identity of document and relevant passage		Relevant to claims
X	JP 61-182559 A	(Ishikawajima) - see Patent Abstracts of Japan, vol.011005, group P533	1,2 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.